National Semiconductor

December 1994

LM79MXX Series 3-Terminal Negative Regulators

General Description

The LM79MXX series of 3-terminal regulators is available with fixed output voltages of −5V, −12V, and −15V. These devices need only one external component—a compensation capacitor at the output. The LM79MXX series is packaged in the TO-220 power package, and is capable of supplying 0.5A of output current.

These regulators employ internal current limiting, safe area protection, and thermal shotdown for protection against virtually all overload conditions.

Low ground pin current of the LM79MXX series allows output voltage to be easily boosted above the preset value with a resistor divider. The low quiescent current of these devices with a specified maximum change with line and load ensures good regulation in the voltage boosted mode.

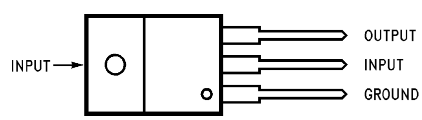
For output voltage other than −5V, −12V, and −15V the LM137 series provides an output voltage range from −1.2V to −57V.

Features

- Thermal, short circuit and safe area protection
- High ripple rejection
- 0.5A output current
- 4% tolerance on preset output voltage

Connection Diagram

TO-220 Plastic Package (T)



TL/H/10483–7

Front View

Order Number LM79M05CT, LM79M12CT or LM79M15CT
See NS Package Number T03B

LM79MXX Series 3-Terminal Negative Regulators

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Input Voltage	
$V_O = -5V$	−25V
$V_O = -12V, -15V$	−35V
Input/Output Differential	
$V_O = -5V$	25V
$V_O = -12V, -15V$	30V
Power Dissipation (Note 2)	Internally Limited
Operating Junction Temperature Range	0°C to +125°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	230°C
ESD Susceptability	TBD

Electrical Characteristics LM79M05C

Conditions unless otherwise noted: $I_{OUT} = 350$ mA, $C_{IN} = 2.2\ \mu F$, $C_{OUT} = 1\ \mu F$, $0°C \leq T_J \leq +125°C$

Part Number			**LM79M05C**			**Units**
Output Voltage			**−5V**			
Input Voltage (Unless Otherwise Specified)			**−10V**			
Symbol	**Parameter**	**Conditions**	**Min**	**Typ**	**Max**	
V_O	Output Voltage	$T_J = 25°C$	−4.8	−5.0	−5.2	V
		$5\ mA \leq I_{OUT} \leq 350\ mA$	−4.75	($-25 \leq V_{IN} \leq -7$)	−5.25	V
ΔV_O	Line Regulation	$T_J = 25°C$ (Note 3)		8 ($-25 \leq V_{IN} \leq -7$)	50	mV
				2 ($-18 \leq V_{IN} \leq -8$)	30	mV
ΔV_O	Load Regulation	$T_J = 25°C$, (Note 3) $5\ mA \leq I_{OUT} \leq 0.5A$		30	100	mV
I_Q	Quiescent Current	$T_J = 25°C$		1	2	mA
ΔI_Q	Quiescent Current Change	With Input Voltage		($-25 \leq V_{IN} \leq -8$)	0.4	mA
		With Load, $5\ mA \leq I_{OUT} \leq 350\ mA$			0.4	mA
V_n	Output Noise Voltage	$T_A = 25°C$, $10\ Hz \leq f \leq 100\ Hz$		150		μV
	Ripple Rejection	f = 120 Hz	54	66 ($-18 \leq V_{IN} \leq -8$)		dB
	Dropout Voltage	$T_J = 25°C$, $I_{OUT} = 0.5A$		1.1		V
I_{OMAX}	Peak Output Current	$T_J = 25°C$		800		mA
	Average Temperature Coefficient of Output Voltage	$I_{OUT} = 5$ mA, $0°C \leq T_J \leq 100°C$		−0.4		mV/°C

Electrical Characteristics LM79M12C, LM79M15C

Conditions unless otherwise noted: $I_{OUT} = 350$ mA, $C_{IN} = 2.2\ \mu F$, $C_{OUT} = 1\ \mu F$, $0°C \leq T_J \leq +125°C$

Part Number			**LM79M12C**			**LM79M15C**			**Units**
Output Voltage				**−12V**			**−15V**		
Input Voltage (Unless Otherwise Specified)				**−19V**			**−23V**		
Symbol	**Parameter**	**Conditions**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	
V_O	Output Voltage	$T_J = 25°C$	−11.5	−12.0	−12.5	−14.4	−15.0	−15.6	V
		$5\ mA \leq I_{OUT} \leq 350\ mA$	−11.4		−12.6	−14.25		−15.75	V
				$(-27 \leq V_{IN} \leq -14.5)$			$(-30 \leq V_{IN} \leq -10.5)$		
ΔV_O	Line Regulation	$T_J = 25°C$ (Note 3)		5	80		5	80	mV
				$(-30 \leq V_{IN} \leq -14.5)$			$(-30 \leq V_{IN} \leq -17.5)$		
				3	50		3	50	mV
				$(-25 \leq V_{IN} \leq -15)$			$(-28 \leq V_{IN} \leq -18)$		
ΔV_O	Load Regulation	$T_J = 25°C$, (Note 3) $5\ mA \leq I_{OUT} \leq 0.5A$		30	240		30	240	mV
I_Q	Quiescent Current	$T_J = 25°C$		1.5	3		1.5	3	mA
ΔI_Q	Quiescent Current Change	With Input Voltage			0.4			0.4	mA
				$(-30 \leq V_{IN} \leq -14.5)$			$(-30 \leq V_{IN} \leq -27)$		
		With Load, $5\ mA \leq I_{OUT} \leq 350\ mA$			0.4			0.4	mA
V_n	Output Noise Voltage	$T_A = 25°C$, $10\ Hz \leq f \leq 100\ Hz$		400			400		μV
	Ripple Rejection	f = 120 Hz	54	70		54	70		dB
				$(-25 \leq V_{IN} \leq -15)$			$(-30 \leq V_{IN} \leq -17.5)$		
	Dropout Voltage	$T_J = 25°C$, $I_{OUT} = 0.5A$		1.1			1.1		V
I_{OMAX}	Peak Output Current	$T_J = 25°C$		800			800		mA
	Average Temperature Coefficient of Output Voltage	$I_{OUT} = 5$ mA, $0°C \leq T_J \leq 100°C$		−0.8			−1.0		mV/°C

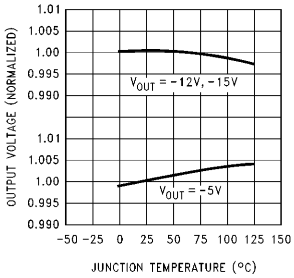
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2: Refer to Typical Performance Characteristics and Design Considerations for details.

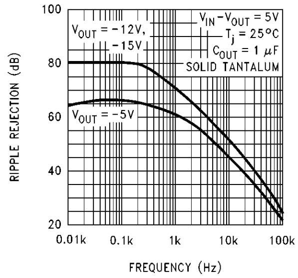
Note 3: Regulation is measued at a constant junction temperature by pulse testing with a low duty cycle. Changes in output voltage due to heating effects must be taken into account.

Typical Performance Characteristics

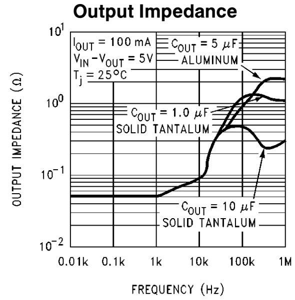
Output Voltage vs Temperature



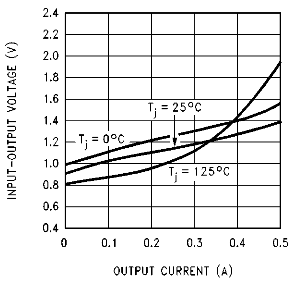
Ripple Rejection



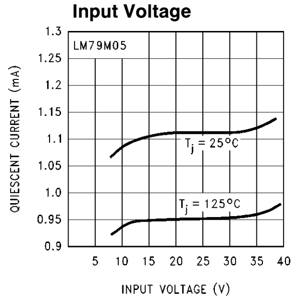
Output Impedance



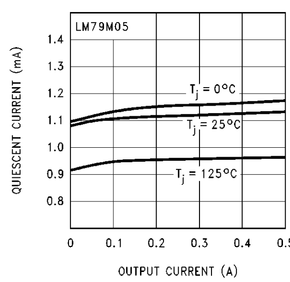
Minimum Input-Output Differential



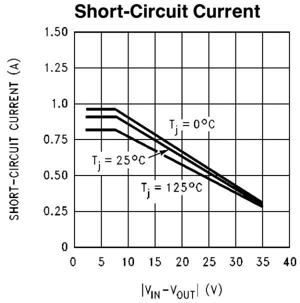
Quiescent Current vs Input Voltage



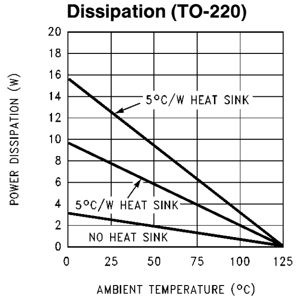
Quiescent Current vs Load Current



Short-Circuit Current



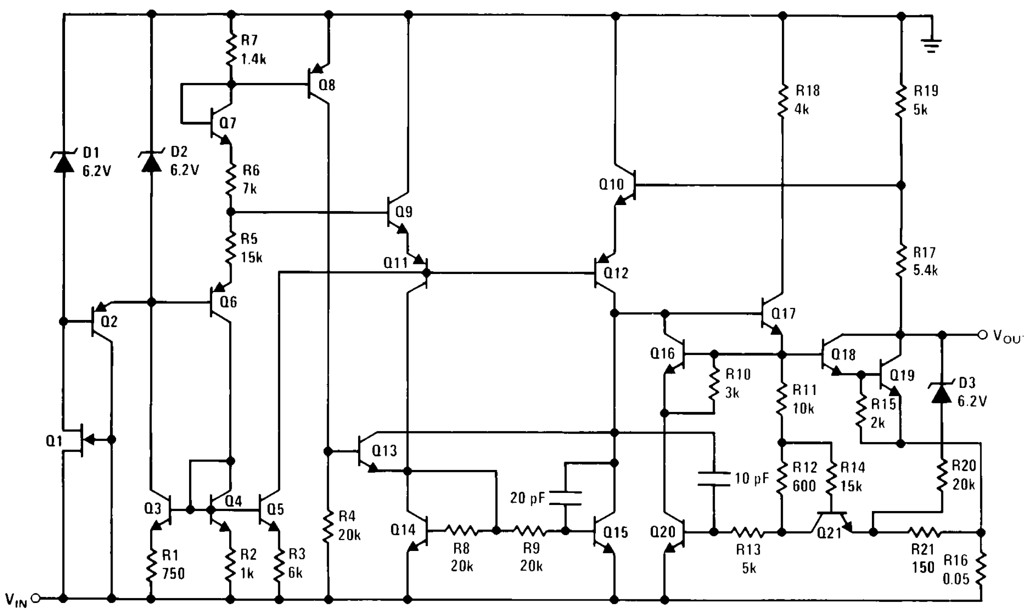
Maximum Average Power Dissipation (TO-220)



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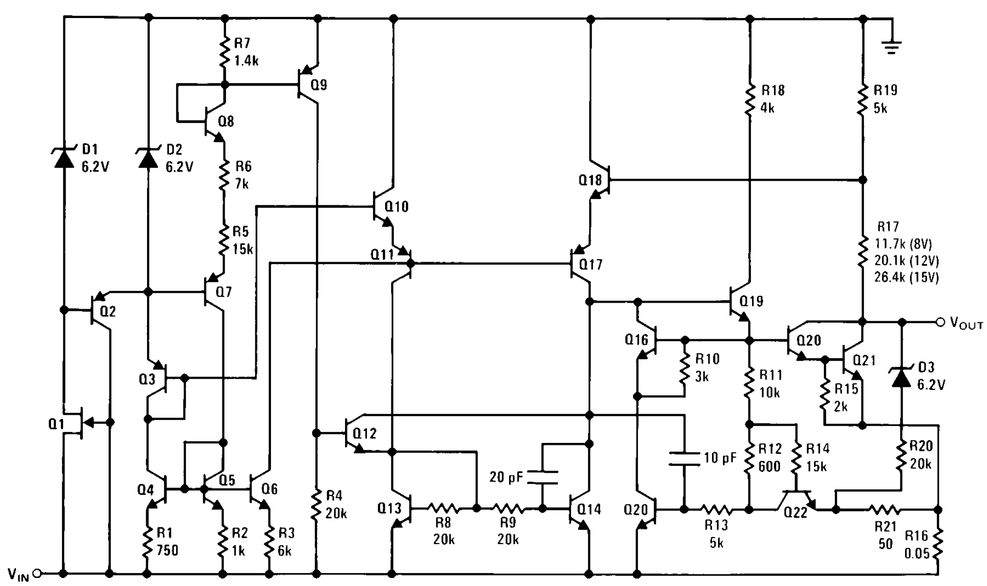
Schematic Diagrams

−5V



TL/H/10483-8

−12V and −15V



TL/H/10483-9

Design Considerations

The LM79MXX fixed voltage regulator series have thermal-overload protection from excessive power, internal short-circuit protection which limits the circuit's maximum current, and output transistor safe-area compensation for reducing the output current as the voltage across the pass transistor is increased.

Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature in order to meet data sheet specifications. To calculate the maximum junction temperature or heat sink required, the following thermal resistance values should be used:

Package	θ_{JC} (°C/W)	θ_{JA} (°C/W)
TO-220	3	40

$$P_{DMAX} = \frac{T_{JMax} - T_A}{\theta_{JC} + \theta_{CA}} \text{ or} \tag{1}$$

$$= \frac{T_{JMax} - T_A}{\theta_{JA}} \text{ (Without a Heat Sink)}$$

$\theta_{CA} = \theta_{CS} + \theta_{SA}$

Solving for T_J:

$T_J = T_A + P_D (\theta_{JC} + \theta_{CA})$ or

$= T_A = + P_D\theta_{JA}$ (Without a Heat Sink)

Where

T_J = Junction Temperature

T_A = Ambient Temperature

P_D = Power Dissipation

θ_{JC} = Junction-to-Case Thermal Resistance

θ_{CA} = Case-to-Ambient Thermal Resistance

θ_{CS} = Case-to-Heat Sink Thermal Resistance

θ_{SA} = Heat Sink-to-Ambient Thermal Resistance

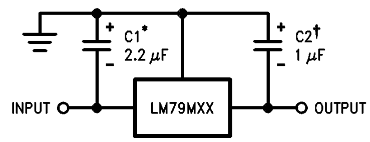
θ_{JA} = Junction-to-Ambient Thermal Resistance

Typical Applications

Bypass capacitors are necessary for stable operation of the LM79MXX series of regulators over the input voltage and output current ranges. Output bypass capacitors will improve the transient response of the regulator.

The bypass capacitors (2.2 μF on the input, 1.0 μF on the output), should be ceramic or solid tantalum which have good high frequency characteristics. If aluminum electrolytics are used, their values should be 10 μF or larger. The bypass capacitors should be mounted with the shortest leads, and if possible, directly across the regulator terminals.

Fixed Regulator



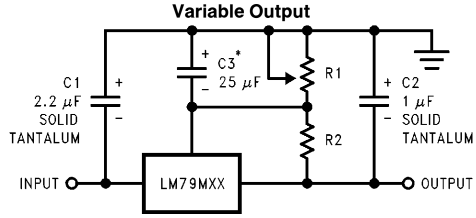
TL/H/10483–2

*Required if regulator is separated from filter capacitor by more than 3″. For value given, capacitor must be solid tantalum. 25 μF aluminum electrolytic may be substituted.

†Required for stability. For value given, capacitor must be solid tantalum. 25 μF aluminum electrolytic may be substituted. Values given may be increased without limit.

For output capacitance in excess of 100 μF, a high current diode from input to output (1N4001, etc.) will protect the regulator from momentary input shorts.

Variable Output



TL/H/10483–3

*Improves transient response and ripple rejection. Do not increase beyond 50 μF.

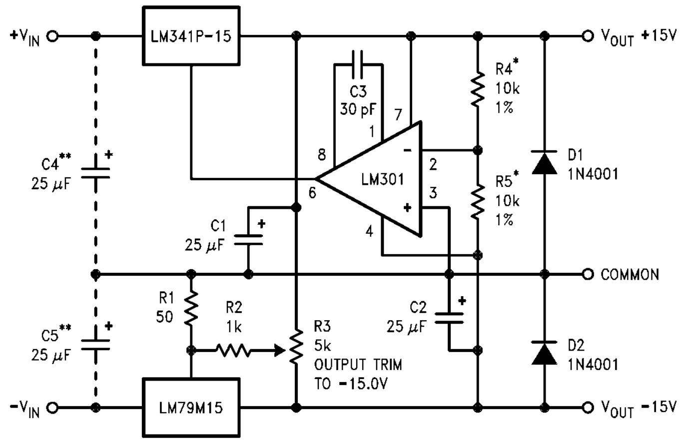
$$V_{OUT} = V_{SET}\left(\frac{R1 + R2}{R2}\right)$$

Select R2 as follows:

LM79M05C	300Ω
LM79M12C	750Ω
LM79M15C	1k

Typical Applications (Continued)

±15V, 1 Amp Tracking Regulators



TL/H/10483–1

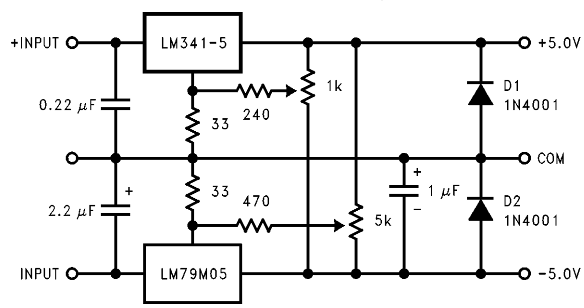
Performance (Typical)

	(−15)	(+15)
Load Regulation at 0.5A	40 mV	2 mV
Output Ripple, C_{IN} = 3000 µF, I_L = 0.5A	100 µVrms	100 µVrms
Temperature Stability	50 mV	50 mV
Output Noise 10 Hz ≤ f ≤ 10 kHz	150 µVrms	150 µVrms

*Resistor tolerance of R4 and R5 determine matching of (+) and (−) outputs.

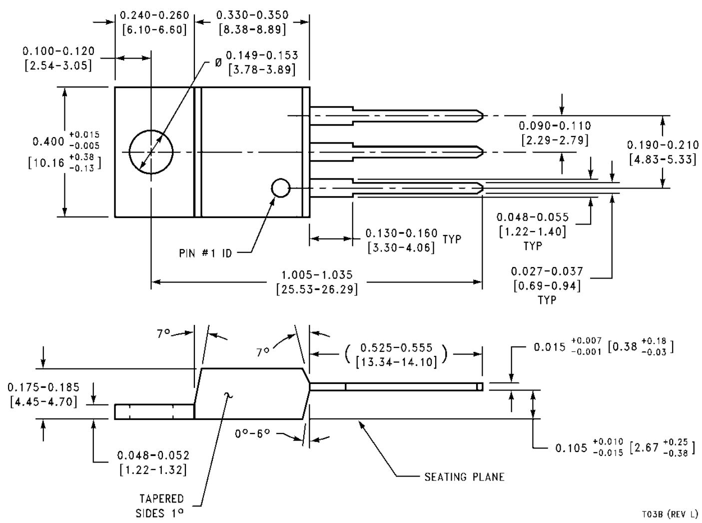
**Necessary only if raw supply filter capacitors are more than 3″ from regulators.

Dual Trimmed Supply



TL/H/10483–4

Physical Dimensions inches (millimeters)



TO-220 Plastic Package (T)
Order Number LM79M05CT, LM79M12CT or LM79M15CT
NS Package Number T03B

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